SOME OF THE ECONOMIC EFFECTS OF SOIL CONSERVATION IN THE SALT CREEK WATERSHED, ZANESVILLE, OHIO 1934-38

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Introduction

This study presents an analysis of some of the changes in farm organization and income from 1934-1938 on 35 soil conservation demonstration farms located in the Salt Creek Watershed near Zanesville, Ohio. This project was established for the purpose of developing cooperatively with the farmer demonstrations of proper land use, and the practical application of necessary soil and water conservation practices.

Detailed farm plans were developed by the Soil Conservation Service and the farmer in regard to proper land use and the control of erosion by one or more of the following methods: strip cropping, contour cultivation and terracing. For the erosion control work, the Soil Conservation Service contributed lime, fertilizer and seed for establishing the alfalfa-grass meadows, and for improving the demonstrational pasture areas. This agency also furnished trees for the demonstrational plantings, and barbed wire for fencing the forests against livestock. On each farm approximately one and one-half per cent of the total farm area was seeded to a permanent alfalfa-grass mixture; three and one-half per cent of the entire farm area was reforested; and an area of permanent pasture equal to eight and one-half per cent of the whole farm was treated. Since the recommended practices of liming and fertilizing were followed on only a portion of each farm, the present study includes only an analysis of the

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farm program as affected by the following practices which were started in 1935: (1) changes in land use, (2) strip cropping, (3) the production of a small acreage of an alfalfa-grass mixture, and (4) the improvement of a portion of the permanent pasture.

The objective of this study was threefold: first, to determine the influence of the revised farm plans upon farm operations and income; second, to develop a technique for analyzing and presenting the available economic and physical data; and third, to determine the type of records that are necessary to measure the economic effects of soil and water conservation practices.

Continuous farm account records were kept on the 35 farms for the period 1935-38, and included a beginning and closing inventory of all livestock, crops, supplies and farming equipment, and also the receipts and expenses on the farm. The 1934 records on the 35 farms were part of a farm management survey that was made previous to any changes effected through the soil conservation program and included data on 226 farms.

Description of the Agriculture of the Area

Location and Soil Types. The Salt Creek Soil Conservation Demonstration Project is located in Muskingum County, Ohio, and includes the entire area of Perry and Salt Creek Townships and portions of Salem, Highland, Union, Washington, Wayne, Richland, Blue Rock and Meigs Townships. The project includes approximately 92,000 acres which represent in a general way large areas of eastern Ohio, Pennsylvania, West Virginia, and Kentucky.

The area is composed principally of the Muskingum, Zanesville, Holston and Wellston soil series of residual sandstone and shale origin. Smaller areas of the Westmoreland, Belmont, Monongahela, Tyler, Pope, Philo, and the Atkins series are found in the watershed. The topography

is rolling to hilly with narrow valleys cutting across the watershed. The average slope of the crop land was approximately 12 per cent. Thus it is not surprising to find that on 60 per cent of the entire area from 25 per cent to 75 per cent of the top soil has been removed by erosion.

Land Use. The acreage planted to the different crops on the 35 farms for the five-year period is given in Table I. In 1934 approximately 30 per cent of the total farm area was in rotated crops; 52 per cent was in pasture; 12 per cent was in woods; and 6 per cent consisted of roads, buildings and waste land. The average acreage per farm of depleting crops for the 35 farms was reduced from 23.6 acres in 1934 to 19.8 acres in 1938. During the same period the acreage of conserving crops was increased on an average from 20.5 to 23.9 acres, due principally to an increase in the acreage of alfalfa hay.

The acreage of crop land for the groups as a whole remained practically the same for the five-year period, since the shifts from crop land to permanent pasture were offset by corresponding shifts from permanent pasture back to crop land. Practically all of the pasture in the area could be classified as permanent pasture. A slight increase in the acreage of forest land and a small decrease in the acreage of permanent pasture occurred as a result of reforesting steep and severely eroded land formerly classified as permanent pasture. The change in the average size of the farming unit from year to year was due to the practice of renting additional land, usually for the production of corn.

The soil conservation program recommended for southeastern Ohio provides for (1) the proper land use, (2) the maintenance of the productivity of the soil, and (3) the control of erosion by one or more of the following practices: strip cropping, contour cultivation, terracing and reforestation.

Table I. Land Use on 35 Salt Creek Farms, 1934-38

(Average acreage per farm)

Land Use	1934	1935	1936	1937	1938
Corn	11.0	10.3	10.2	9.8	9.7
Oats	2.2	3.2	1.7	2.6	1.1
Wheat and rye	9.8	9.1	8.9	7.6	8.4
Soybean hay	.1	.4	.1	.4	.2
Other depleting crops	.5	.5	.3	.4	.4
Total depleting crops	23.6	23.5	21.2	20.8	19.8
Clover hay	4.3	2.9	4.6	1.1	7.1
Clover-timothy hay	9.8	6.5	7.6	9.3	6.5
Timothy hay	4.9	8.8	6.0	9.2	5.6
Alfalfa seeding(1)	.0	.8	.1	.2	.0
Alfalfa hay(2)	1.5	2.3	4.5	4.7	4.7
Total conserving crops	20.5	21.3	22.8	24.5	23.9
Rotated area	44.1	44.8	44.0	45.3	43.7
Woods	18.6	21.2	21.4	21.5	21.7
Pasture(3)	77.8	72.8	74.3	73.5	72.4
Roads, buildings, waste	9.5	7.9	7.7	7.7	7.8
Total farm area	150.0	146.7	147.4	148.0	145.6

(1) Seeded without a companion crop.
(2) Includes both alfalfa in rotation and permanent alfalfa.
(3) Includes a small amount of rotation pasture.

On the 35 farms, 6.4 acres per farm were strip-cropped in 1935; 11.5 acres were strip-cropped in 1936 and 13.8 acres, or 31 per cent of the crop acres, were farmed in this manner in 1937. The permanent pasture improvement program included the treatment of 11.6 acres per farm in 1935, 2.6 additional acres in 1936 and 1.4 acres in 1937. A total of 21 per cent of the pasture was, therefore, treated during the three-year period. Trees were planted on 3.2 acres per farm in 1935, .9 acres in 1936 and .3 acres in 1937. The area reforested did not represent the entire area that should have been planted to trees, but only the area that was reforested for demonstrational purposes. A small amount of terracing was done on 3 of the 35 farms.

A study of the Census data of Muskingum County showed that during the period 1850-1930 no great change occurred in the acreage of corn and

wheat; however, the acreage of oats was reduced approximately one-half, and the acreage of meadow was doubled.

Crop Yields. The crop yields per acre on the 35 farms agree closely with the Muskingum County yields reported by the United States Crop Reporting Service. Table II gives the yields for the five-year period. The low yields of wheat and hay in 1934 were due to a severe drought.

Table II. Crop Yields on 35 Salt Creek Farms, 1934-38

Crop		1934	1935	1936	1937	1938
Corn	bu.	42.7	42.4	38.1	38.0	44.4
Oats	bu.	25.2	22.9	16.9	20.2	22.5
Wheat	bu.	8.8	19.3	11.4	18.3	12.5
Clover hay	tons	.9	1.4	1.1	1.5	1.6
Clover-timothy hay	tons	.8	1.1	1.1	1.2	1.1
Timothy hay	tons	.6	1.0	.8	1.0	.9
Alfalfa hay	tons	2.5	2.0	1.8	2.1	2.0

To determine the effects of a soil and water conservation program upon yields by the analysis of farm records covering a relatively short period of time is difficult at best. Increases in yields may be expected to follow the adoption of such water conservation practices as strip cropping, contour cultivation and terracing. Also, the application of commercial fertilizers and the plowing under of larger crop residues should increase yields. Since only a few additional acres of alfalfa and clover have been plowed under for corn, it would appear that any increase in crop yields from 1934-38 due to the adoption of soil conservation practices would come principally as a result of water conservation, and any additional fertilizer that might have been applied.

Livestock Numbers. Table III shows that the amount of livestock for the five-year period remained fairly constant at approximately 20 animal units

with only a slight variation in the proportion of the various classes of livestock. From 1934-38 a large loss of lambs occurred due to internal parasites. Since the Salt Creek area is adapted to the production of hay instead of grain, the livestock enterprises should consist principally of hay-consuming animals. The small decrease in the amount of livestock in 1935, 1936 and 1937 was due to a reduction in the amount of feed as a result of the droughts in 1934 and 1936, rather than a decrease in the feed supply as a result of the changed farm practices.

Table III. Average Number of Animal Units(1) on 35 Salt Creek Farms, 1934-38

Class	1934	1935	1936	1937	1938
Cows	7.0	6.5	6.0	6.4	6.9
Other cattle	4.6	4.2	4.0	4.2	4.9
Horses	2.4	2.4	2.4	2.5	2.8
Sheep	4.7	4.2	3.7	3.6	4.5
Hogs	.8	.9	.9	.7	.7
Poultry	.9	.9	1.0	1.1	1.2
Total	20.4	19.1	18.0	18.5	21.0

(1) An animal unit is equal to: 1 horse, 1 cow, 2 head of young stock, 10 ewes, 20 lambs, 3 brood sows, 1400 lb. gain in hogs or 100 hens.

A study of the trends in livestock production in Muskingum County showed a decrease in horses of approximately 40 per cent from 1850-1930. During this same period cattle decreased about 17 per cent and hogs 70 per cent. The production of sheep increased until 1880 and then declined approximately 50 per cent to 1930. These changes in livestock production were associated with a shift from beef to dairy cattle, inadequate sheep parasite control, an increase in the amount of poultry, and a decline in the carrying capacity of pastures.

Labor Income. The labor income for the 35 farms, by years, for the period 1934-38 is shown in Table IV, also the farm receipts and expenses leaving out of consideration the estimated value of the materials contributed by the Soil Conservation Service. Table V is a revision of Table IV with the addition of an estimate of the value of the contributions of this agency for the initiation and operation of the soil and water conservation practices. These two tables show that the value of the materials contributed by the Soil Conservation Service was greatest in 1935. In that year the estimated cost of the contribution was $163, compared with $36 in 1936, $20 in 1937 and no contribution in 1938. The large contribution was made by the Soil Conservation Service in 1935 in order to establish the demonstrational work as rapidly as possible.

In the beginning of this report it was stated that such practices as fertilizing and liming were actually put into operation for demonstrational purposes on only a portion of each farm. Therefore, the labor income figures in Table V do not represent a situation where the complete application of these needed materials was made on the entire farm. In actual practice, the farmer should plan to make the same cash outlay each year for lime, fertilizer and seed, thus distributing the cost over a period of years. If all of the recommended soil and water conservation practices were adopted on the 35 farms, approximately $150 to $200 additional expense would be required each year for the first five-year period for liming the cropland and treating the permanent pasture. After a soil and water conservation program has been followed for five years the above figures could probably be reduced to approximately $125 each year. After a soil conservation program is in complete operation the farmer should be able on most farms to maintain and in many cases increase his labor income, and at the same time maintain the farm as a producing unit.

Table IV. Average Labor Income on 35 Salt Creek Farms, 1934-38, Excluding Cost of Materials Contributed by the Soil Conservation Service

	1934	1935	1936	1937	1938
Livestock receipts	740	1065	1163	1149	1011
Crop receipts	32	115	127	117	116
Miscellaneous receipts(1)	174	166	387	380	112
Total receipts	946	1346	1677	1646	1239
Current expenses	324	403	405	475	432
Miscellaneous expenses(2)	48	246	292	297	196
Total expenses	372	649	697	772	628
Farm income	574	697	980	874	611
Interest on investment at 4%	217	195	198	211	217
Labor income	357	502	782	663	394

(1) Also includes any increases in inventory.
(2) Also includes any decreases in inventory and purchase of livestock.

Table V. Average Labor Income on 35 Salt Creek Farms, 1934-38, Including Estimated Cost of Materials Furnished by the Soil Conservation Service

	1934	1935	1936	1937	1938
Total receipts(1)	946	1346	1677	1646	1239
Total expenses(2)	372	812	733	792	628
Farm income	574	534	944	854	611
Interest on investment at 4%	217	202	199	212	217
Labor income	357	332	745	642	394

(1) Includes any increases in inventory.
(2) Includes any decreases in inventory and purchase of livestock.

Relationship Between Physical Factors and Labor Income

As a basis for judging the effects of certain external influences on farm returns an attempt was made to study the relationship between some of the physical factors and labor income. The analysis of the data disclosed that one of the chief factors influencing labor income was the size of the farm. An attempt was made to weight the size of the farm by using other

factors such as depth of topsoil and productivity, but after these weightings were made the correlation was no greater than before. Further analysis showed that the soil types, slope and erosion classes occurred in about the same ratio on the large farms as they did on the small farms, indicating that the large and small farms occur in the same group, and, therefore, probably do not lend themselves readily to analysis on the basis of these physical factors. However, with the physical factors as well distributed as they are an analysis based on size of farm may be said to be a logical one.

Although labor income seemed to depend more on size of farm and volume of business than any one physical factor this should not be interpreted to mean that such physical factors as soil type, slope and erosion do not affect labor income. The analysis emphasizes the difficulty of showing the relationship between a single factor and labor income which is the result of the combination of many factors working together.

Relationship Between Land Use and Other Factors

As a further basis for judging the relationships existing in the group of farms between physical factors, and the results of the soil and water conservation program as a basis for developing effective analytical technique, the farms were sorted on the basis of the "shifts in land use" reported as a part of the soil and water conservation measures. These shifts, as stated previously, follow from the objectives of the soil and water conservation program, i.e., the restriction of crop raising to that land adapted to crop production, the retirement to permanent pasture of land too steep for crops and the relegation of waste and some pasture land to crops. Thus, the shifts recognized on the 35 farms in the Salt Creek

area may be designated A, B, C and D as follows:

A. Farms on which the depleting crops were decreased and the conserving crops were increased. The farms in this group represented approximately 54 per cent of the farms.

B. Farms on which both the depleting and conserving crops were increased. This group represented approximately 23 per cent of the farms.

C. Farms on which both the depleting and conserving crops were decreased. Approximately 18 per cent of the farms were in this group.

D. Farms on which the depleting crops were increased and the conserving crops were decreased. This group constituted only 5 per cent of the farms.

The term "crops" in the preceding groups does not include pasture and woods. Therefore, it is possible that the acreage of soil conserving crops might be decreased yet the total "soil conserving cover" might not decrease as a result of shifting land from hay to pasture. In groups B and D an increase in depleting crops may not be an improvement from the standpoint of soil conservation. However, such an increase may be made on a few farms, provided proper methods are adopted to control erosion and maintain soil fertility. From the standpoint of increasing the labor income from the farm an increase in depleting crops may sometimes be desirable.

In order to study some of the changes in the replanned farming units a detailed discussion of Groups A, B and C will be presented. No further consideration will be given to Group D since this group represented only 5 per cent of the farms in the study. From a soil conservation standpoint the question may be asked how the revised farm plans for Group D would permit an increase in depleting crops and a decrease in conserving

Table VI. Some Comparisons Between Group A, B and C Farms in the Salt Creek Area

		Group		
		A(1)	B(2)	C(3)
Farms in group	number	12	5	4
Average size of farm	acres	167.0	164.0	138.0
Average size of rotated area	acres	47.0	37.0	47.0
Average slope of crop land	per cent	12.2	12.2	8.2
Average slope of pasture land	per cent	19.0	17.5	16.0
Erosion factor(4) for crop land		2.7	2.8	3.2
Average yield of corn, 1934-38	bu. per acre	42.0	45.0	34.0
Average yield of oats, 1934-38	bu. per acre	22.0	28.0	19.0
Average yield of wheat, 1934-38	bu. per acre	14.0	16.0	14.0

(1) Decrease in depleting crops; increase in conserving crops.
(2) Increase in depleting crops; increase in conserving crops.
(3) Decrease in depleting crops; decrease in conserving crops.
(4) An erosion factor is an average of the conventional Soil Conservation Service erosion classes weighted with the area in each class.

crops. Such a change is possible since less depleting crops had been raised under the old farm plans than could have been raised according to present soil conservation recommendations.

It should be noted that not all of the 35 farms have been included in the four groups because any farming unit that changed in size during the period was eliminated from the group study. Thus, the number of farms was reduced to the extent that the analysis approaches a study of several farms in each group. The author recognizes the limitations of small samples and, therefore, regards the study as a group analysis based on a few individual cases.

Comparisons Between Groups A, B and C

Land Use. The land use on the 12 farms in Group A on which the depleting crops were decreased and the conserving crops were increased is shown in Table VII. This group of farms is representative of the majority of the farms in the area. A reduction in grain crops from 25.3 acres to 17.7 acres

Table VII. Land Use 1934-38 on 12 Salt Creek Farms on Which the Depleting Crops Were Decreased and the Conserving Crops Were Increased

(Average acreage per farm)

Land Use	1934	1935	1936	1937	1938
Corn	11.3	8.9	8.7	9.4	8.4
Oats	3.5	1.7	1.0	1.9	1.1
Wheat	10.5	11.1	8.6	7.7	8.2
Total depleting crops	25.3	21.7	18.3	19.0	17.7
Clover hay	2.2	2.0	5.7	1.2	6.2
Clover-timothy hay	13.0	9.1	8.9	8.5	9.6
Timothy hay	6.1	11.2	8.2	14.5	6.9
Alfalfa hay(1)	.9	2.1	4.3	4.4	4.2
Total conserving crops	22.2	24.4	27.1	28.6	26.9
Rotated area	47.5	46.1	45.4	47.6	44.6
Woods	26.2	28.4	28.8	29.0	29.2
Pasture(2)	87.3	86.7	87.0	85.3	87.4
Roads, buildings, waste	6.0	5.8	5.8	5.1	5.8
Total farm area	167.0	167.0	167.0	167.0	167.0

(1) Includes alfalfa in rotation and permanent alfalfa.
(2) Practically all of the pasture may be classified as permanent pasture.

and an increase in hay crops from 22.2 to 26.9 acres was made during the period. On a percentage basis these figures show approximately a 30 per cent decrease in grain crops and a 20 per cent increase in hay crops. In addition to the changes in land use, an average of 13.5 acres of permanent pasture per farm was treated in 1935, 4.0 additional acres in 1936 and 3.6 acres in 1937. During 1935, an average of 7.3 acres per farm was strip-cropped, and in 1936 and 1937, 11.6 acres were farmed in this manner.

Table VIII gives the land use on the five farms in Group B on which both the depleting and conserving crops were increased; however, the proportionate increase in conserving crops was greater than the increase in depleting crops. In 1934 approximately 42 per cent of the total rotated area was in depleting crops, but in 1938 this figure had been reduced to 37 per cent. The conserving crops in 1934 included 58 per cent of the rotated area and in 1938, 63 per cent. The decrease in the acreage of

Table VIII. Land Use on 5 Salt Creek Farms on Which the Depleting and Conserving Crops Were Increased from 1934-38

(Average acreage per farm)

Land Use	1934	1935	1936	1937	1938
Corn	8.2	9.6	8.8	9.1	8.2
Oats	1.3	3.6	2.0	3.8	.6
Wheat	6.0	6.1	8.4	6.0	8.6
Soybean hay	.0	.4	.0	.0	.0
Total depleting crops	15.5	19.7	19.2	18.9	17.4
Clover hay	7.0	2.8	3.5	.5	7.8
Clover-timothy hay	8.2	4.7	9.2	15.8	4.8
Timothy hay	2.4	12.0	8.9	7.4	7.0
Alfalfa hay(1)	3.8	5.2	6.3	6.8	9.6
Total conserving crops	21.4	24.7	27.9	30.5	29.2
Rotated area	36.9	44.4	47.1	49.4	46.6
Woods	16.3	17.4	17.4	17.4	17.4
Pasture(2)	97.6	91.0	88.3	86.0	88.8
Roads, buildings, waste	13.0	11.0	11.0	11.0	11.0
Total farm area	163.8	163.8	163.8	163.8	163.8

(1) Includes alfalfa in rotation and permanent alfalfa.
(2) Practically all of the pasture may be classified as permanent pasture.

oats has been offset by an increase in the acreage of wheat. The hay acreage exclusive of alfalfa increased from 17.6 to 19.6 acres during the five-year period, and the alfalfa acreage increased from 3.8 to 9.6 acres. Although the acreage of grain crops was increased, the amount of erosion on the crop land was reduced by strip cropping and contour cultivation. In 1935 an average of 8.9 acres per farm was strip cropped, and in 1936 and 1937, 19.8 acres were farmed in this manner. In addition to the change in land use an average of 13 acres per farm of permanent pasture was treated in 1935, 2.4 acres in 1936 and .8 acres in 1937.

On the Group C farms where erosion had been severe, the change in land use by retiring crop land to permanent pasture has resulted in a reduction in both depleting and conserving crops. An analysis of this type of change is shown in Table IX. The acreage of depleting crops was reduced from 24.6 to 21.6 acres and the conserving crops from 22.8 to

Table IX. Land Use 1934-38 on 4 Salt Creek Farms on Which the Depleting and Conserving Crops Were Decreased

(Average acreage per farm)

Land Use	1934	1935	1936	1937	1938
Corn	8.9	9.3	8.4	8.5	9.0
Oats	.0	1.0	.0	1.7	.7
Wheat	12.9	9.0	9.0	6.0	8.0
Potatoes	2.2	2.5	2.2	2.4	2.5
Soybean hay	.6	.9	.5	1.0	1.4
Total depleting crops	24.6	22.7	20.1	19.6	21.6
Clover hay	8.7	3.8	4.4	.5	9.2
Clover-timothy hay	11.8	11.7	11.5	10.0	.8
Timothy hay	2.3	1.2	2.5	5.4	5.5
Alfalfa hay(1)	.0	.0	2.5	3.1	2.1
Total conserving crops	22.8	16.7	20.9	19.0	17.6
Total rotated area	47.4	39.4	41.0	38.6	39.2
Pasture(2)	73.7	80.0	77.6	79.9	77.4
Woods	13.5	15.5	16.7	16.7	17.2
Roads, buildings, waste	3.9	3.6	3.2	3.3	4.7
Total rotated area	138.5	138.5	138.5	138.5	138.5

(1) Includes alfalfa in rotation and permanent alfalfa.
(2) Practically all of the pasture may be classified as permanent pasture.

17.6 acres during 1934-38. The permanent pasture improvement program included the treatment of an average of 12.4 acres per farm in 1935 and .5 acres in 1937. Strip cropping was practiced on an average of 4 acres per farm in 1935 and on 10 acres in 1936 and 1937.

Productivity Balance. Under the new farm plans the calculated rate of soil depletion of the crop land changed from 1.0 per cent per year in 1934 to .0 per cent per year in 1938 on the Group A farms. On the Group B farms the change in the rate of soil depletion was from .5 per cent in 1934 to .0 per cent in 1938 according to the calculation. Practically no change in the rate of soil depletion on the crop land occurred on the Group C farms. The method used in this study to show the rate of change in soil productivity was developed by the Ohio Agricultural Experiment

Table X. Calculated Change in Productivity Balance of Crop Land on Three Groups of Farms in the Salt Creek Area 1934-38

Group	Productivity Balance 1934	Productivity Balance 1938
	Per cent	Per cent
A - Decrease depleting; increase conserving crops	-1.0	.0
B - Increase depleting; increase conserving crops	- .5	.0
C - Decrease depleting; decrease conserving crops	- .6	- .6

Station[1] and is based on the percentage of depleting and conserving crops in the rotation, fertility practices and erosion control. As shown in Table X Groups A and B were maintaining the productivity of the soil in 1938, while Group C was depleting the soil at the rate of .6 per cent per year. In order to bring Group C nearer in balance it will be necessary to improve the quality of the hay by raising more legumes. Any improvement in the stand of hay will assist in controlling erosion.

Livestock Production. The change in livestock production on the three groups of farms is shown in Table XI. On the Group B farms the amount of livestock was increased from the time the farm was reorganized; on the Group A farms the amount of livestock was reduced during the period of readjustment; and on the Group C farms less livestock was kept under the new farm plans. The amount of feed produced during the period was somewhat below normal due to the droughts in 1934 and 1936. Therefore, it is reasonable to believe that this reduction in feed may have been responsible for a larger reduction in livestock numbers than would have occurred had the crop yields been normal.

The relative change in the trend of livestock production on the three groups of farms is correlated with the amount of feed produced. On Group B farms where the greatest amount of feed was available after the

(1) Salter, R. M., Lewis, R. D., and Slipher, J.A. Our Heritage, The Soil. Ohio State University Extension Service Bulletin 175, 1936.

Table XI. Change in Livestock Production on Three Groups of Farms in the Salt Creek Area 1934-38

(Average number of animal units per farm)

Year	Group		
	A(1)	B(2)	C(3)
1934	21.9	22.2	15.6
1935	20.4	22.6	14.6
1936	20.2	23.2	14.1
1937	21.1	22.6	14.9
1938	22.5	24.3	14.9

(1) Decrease in depleting crops; increase in conserving crops.
(2) Increase in depleting crops; increase in conserving crops.
(3) Decrease in depleting crops; decrease in conserving crops.

change in land use the livestock was increased most, while on the Group C farms where the acreage of the crop land was reduced the livestock numbers declined below the figure for 1934. The increase in the amount of livestock on the Group A and B farms consisted of hay-consuming instead of grain-consuming animals. The production of more feed is not always accompanied by an increase in livestock numbers. In some cases the additional feed may be used to increase production per animal instead of being fed to more livestock.

Net Gain. In Table XII an attempt has been made to calculate the net gain in the market value of the crops above the additional expenses of adopting the soil and water conservation practices on the Group A farms. By using average yields for the farms in this group and average prices for the area, such factors as the influence of the weather, diseases, changes in the price level, etc., have been ignored. In order to reduce the number of computations and estimates, changes were calculated on the basis of the 1934 data. Thus, if an increase in any item occurred over the 1934 value it was given a plus value and vice versa. Under the new farm plans

the following increases in feed units[1] based on average yields for the area would occur over 1934; 3 per cent for 1935; 10 per cent for 1936, 15 per cent for 1937 and 11 per cent for 1938. As a result of the change in land use less grain will be produced (unless yields increase greatly) but more hay should be available for livestock production. This situation will probably lead either to the keeping of less grain-consuming and more hay-consuming livestock, or a change in feeding practices. However, with an improvement in the type of hay and the quality of the pasture it should be possible to maintain the production from the hay-consuming livestock although feeding less grain.

Table XII. Calculated Net Gain from 1934 in Market Value of Crops Over Additional Expenses in Adopting Some Soil Conservation Practices on the Group A Farms in the Salt Creek Area

	1935	1936	1937	1938
	Dollars	Dollars	Dollars	Dollars
Increase or decrease in value of crops[1]	- 13	+ 30	+ 79	+ 34
Gain from decreased labor and power	23	27	14	33
Additional expenses for lime, fertilizer and seed	180	42	0	0
Net gain over expenses	-170	+ 15	+ 93	+ 67

(1) Prices used: corn, $.60 bu.; oats, $.35 bu.; wheat, $.80 bu.; hay, $9.00 ton; alfalfa hay, $10.00 ton; pasture, $.22 per feed unit. Yields per acre used: corn, 42 bu.; oats, 22 bu.; wheat, 14 bu.; hay, 1.0 ton; alfalfa hay, 2.0 ton; untreated pasture, 1,100 lbs.; and treated pasture 2,800 lbs. dry matter.

The calculated market value of the crops produced after the reorganization in crop acreage shows an increase from 1936-38 over 1934 principally as a result of more alfalfa hay. If the labor and power requirements per acre should remain the same under the new farm plan, less

(1) A feed unit is equal to: 1 bu. corn, 2 bu. oats, .9 bu. wheat, .04 tons alfalfa hay, .05 tons mixed hay, or .04 acres of average pasture.

expense should be required for crop production. In the calculation the reduction in the labor and power requirements has been treated as a decrease in expenses. Over the four-year period the estimated change in the market value of the crops is practically equal to the increased expense of adopting the soil conservation practices. If the additional hay were fed to livestock it would seem reasonable to expect that the labor income for this group of farms could be maintained or increased somewhat by the adoption of the soil conservation practices; whereas, if soil depleting practices were followed the farm income would decline.

During the period of readjustment in crop production the net income will probably decline due to the fact that the total benefits from lime and fertilizer are not manifest immediately after application. Table XII shows a decrease of $170 in the market value of the crops over the additional expenses for 1935 and an increase of $15 for 1936, $93 for 1937 and $67 for 1938. The $180 expenditure for 1935 consisted of lime, fertilizer and seed for pasture and the establishment of alfalfa. This large expenditure in 1935 was made in order to improve a portion of the hay and permanent pasture land as quickly as possible for demonstrational purposes. Ordinarily, the farmer should find it more convenient from the standpoint of cash outlay, labor requirements and the amount of feed produced to improve practically the same amount of hay and permanent pasture land each year.

The calculated market value of the crops over the additional expenses of adopting the soil conservation practices on the Group B farms is presented in Table XIII. According to estimates based on average yields for the group, the feed units produced should increase over 1934 approximately 5 per cent for 1935, 10 per cent for 1936, 14 per cent for 1937

and 17 per cent for 1938. As a result of the increase in the acreage of crop land more hay and grain should be available; however, due to the decrease in pasture acreage, a slight decrease in the feed units of pasture will occur until the pasture improvement program has had time to produce maximum results. The change in land use should tend to increase the volume of business on the farm unless the amount of livestock is reduced.

Table XIII. Calculated Net Gain from 1934 in Market Value of Crops Over Additional Expenses in Adopting Some Soil Conservation Practices on the Group B Farms in the Salt Creek Area

	1935	1936	1937	1938
	Dollars	Dollars	Dollars	Dollars
Increase in value of crops(1)	95	140	172	184
Additional expenses for labor and power	41	42	51	42
Additional expenses for lime, fertilizer and seed	186	39	25	0
Net gain over expenses	-132	+ 59	+ 96	+142

(1) Prices used: corn, $.60 bu.; oats, $.35 bu.; wheat, $.80 bu.; hay, $9.00 ton; alfalfa hay, $10.00 ton; pasture, $.22 per feed unit. Yields per acre used: corn, 45 bu.; oats, 28 bu.; wheat, 16 bu.; hay, 1.0 ton; soybean hay, 2.0 ton; alfalfa hay, 2.0 ton; untreated pasture, 1,100 lbs.; treated pasture, 2,800 lbs. dry matter.

In Table XIII the increased amount of labor and power has been treated as an additional cash expense. Since data are not available for labor and power requirements on strip-cropped land, estimates have been based on labor and power requirements for land not strip-cropped. On some farms the additional amount of labor required may be supplied by using available family labor, while on other farms it may be necessary to hire some labor.

The analysis of the Group B farms indicates that the labor income may be increased, the amount of increase depending upon the utilization of the additional feed. If the additional expense for lime, fertilizer, seed, and labor is subtracted from the calculated market value of the additional crops, a net gain of $165 is obtained for the four-year period. By utilizing the additional feed for livestock production it should be possible to increase returns beyond this figure. In some cases, however, the farmer may find it difficult to hire additional labor, and as a result he may change to a less intensive livestock system of farming. In that event the net income may increase only slightly over the base period. The new farm plan for this group offers, in addition to the conservation of the soil, the possibilities of increasing the volume of farm business. The economic effects of the recommended soil conservation practices for this group should be an increase in labor income and the maintenance of the farm as a producing unit.

The calculated market value of the crops above the additional expenses in adopting the soil conservation practices on the Group C farms is shown in Table XIV. The estimates based on average yields for the group show that the feed units produced would be approximately 4 per cent less for 1935, and 6 per cent more for the years 1936-38 than for 1934. The reduction of the depleting and conserving crops will reduce the amount of feed produced until the increases in production are obtained from the permanent pasture treatment. Table XIV shows a decrease in the calculated market value of the crops based on a ten-year average of farm prices for the area. Some labor has been saved by the reduction in the acres in crops; however, if this labor cannot be profitably used in some other manner it may represent a definite loss in labor income.

Table XIV. Calculated Net Gain from 1934 in Market Value of Crops Over Additional Expenses in Adopting Some Soil Conservation Practices on the Group C Farms in the Salt Creek Area

	1935	1936	1937	1938
	Dollars	Dollars	Dollars	Dollars
Decrease in value of crops(1)	71	19	36	25
Gain from decreased labor and power	20	25	25	18
Additional expenses for lime, fertilizer and seed	152	6	0	0
Net gain over expenses	-183	0	- 11	- 7

(1) Prices used: corn, $.60 bu.; oats, $.35 bu.; wheat, $.80 bu.; hay, $9.00 ton; alfalfa hay, $10.00 ton; pasture $.22 per feed unit. Yields per acre used: corn, 34 bu.; oats, 19 bu.; wheat, 14 bu.; hay, 1.0 ton; soybean hay, 2.0 ton; alfalfa hay, 1.9 ton; untreated pasture, 1,100 lbs.; treated pasture, 2,800 lbs. dry matter.

The Group C farms had been following a land use pattern that required both a reduction in the acreage of depleting and conserving crops in order to control erosion. The immediate result of a reduced crop acreage will be a decrease in the volume of farm business and consequently a reduction in the labor income. Since some of the crop land had lost over 75 per cent of the top soil, responses to lime and fertilizer applications will probably be only moderate in most cases. Although the labor income may decline for several years as a result of the adoption of the soil conservation practices, this should not be construed to mean that soil conservation may not be profitable over a period of years. If soil depleting practices are followed yields will continue to decline with the result that the land will be eventually retired to permanent pasture, and in some cases abandoned.

Labor Income. The relative changes in labor income on the three groups of farms is illustrated in Figure 1 in which 1934 was used as a base. A part of the change in labor income was due to the fluctuating price level.

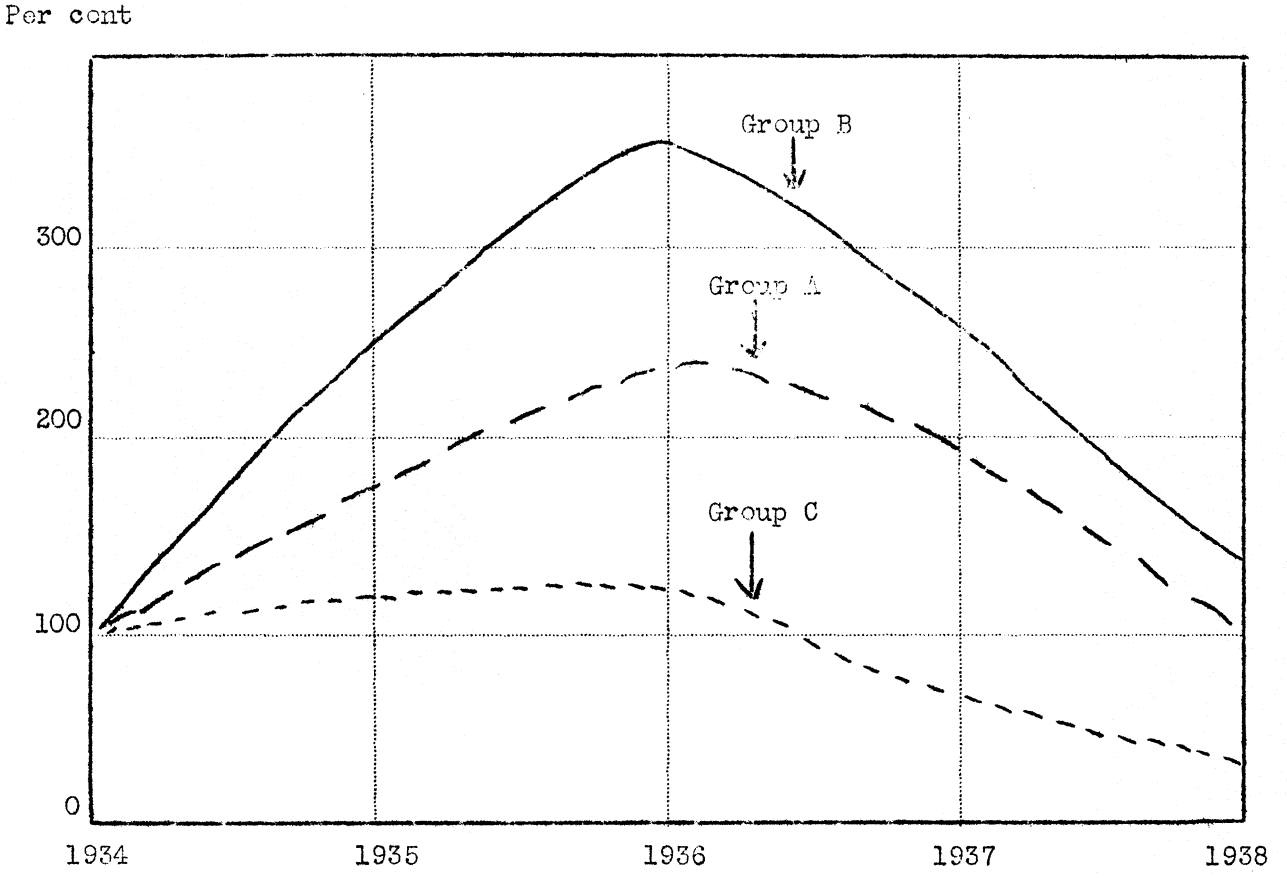

FIGURE 1. Relative Change in Labor Income on Farm Groups A, B and C, Salt Creek Area, 1934-38

(1934 = 100)

The greatest increase in labor income occurred on the Group B farms on which the crop acreages and livestock numbers were increased. On the Group C farms where the crop acreages and livestock numbers were reduced the labor income decreased during the five-year period. This labor income relationship between the three groups is in agreement with the preceding "advance estimates" of the probable economic consequences of adopting the soil and water conservation practices.

Studies of Individual Farms

The changes in farm organization effected by the adoption of some soil conservation practices on two farms will be used to illustrate that several years may be required before the farmer realizes complete benefits from the conservation practices. If the amount of lime and fertilizer applied remains the same increases in crop yields will come first from moisture conservation, as a result of strip-cropping, terracing and contour cultivation. The returns from the application of lime and fertilizer on pastures and for establishing alfalfa meadows will begin to be realized after two years have elapsed. Increases in crop yields due to the plowing under of larger crop residues will require a period of time of at least five years after lime is applied to the land. Thus, the complete results from the adoption of soil conservation practices cannot be measured in a short period of time.

190 Acre Farm. Table XV shows the change in land use on a 190 acre farm on which the depleting crops were decreased and the conserving crops were increased. During the five-year period the acreage of depleting and conserving crops has fluctuated considerably. This is characteristic of the changes that may be expected during the period of reorganization. Under the present farm plans the recommended changes in land use will not

Table XV. Land Use 1934-38 on a 190 Acre Salt Creek Farm on Which the Depleting Crops were Decreased and the Conserving Crops Were Increased

Land Use	1934	1935	1936	1937	1938
	Acres	Acres	Acres	Acres	Acres
Corn	10	9½	9	9	6
Oats	7	3½	5	9	0
Wheat	8	3½	5	5	5
Total depleting crops	25	16½	19	23	11
Clover hay	0	0	15	0	6
Mixed hay	20(1)	0	0	2	13(2)
Timothy hay	15	29	10	25	20
Alfalfa hay	0	1½	3	5	0
Total conserving crops	35	30½	28	32	39
Rotated area	60	47	47	55	50
Woods	25	25	25	25	25
Pasture(3)	90	101	100	98	103
Roads, buildings, waste	15	17	18	12	12
Total farm area	190	190	190	190	190

(1) Timothy-clover mixture.
(2) Timothy-clover and timothy-alfalfa mixture.
(3) Includes rotation and permanent pasture.

be in full effect until 1940. At that time all of the crop land will be either strip-cropped or terraced. The permanent pasture improvement program, although not complete, included the treatment of 17 acres in 1935 and 9 acres in 1937 on which 2 tons of ground limestone and 400 pounds of 20 per cent superphosphate per acre were applied. The forestry improvement program consisted mainly in protecting the trees from livestock. The rate of soil depletion, calculated according to the Ohio Method, changed from -.6 per cent in 1934 to + .2 per cent in 1938.

During the five-year period the number of animal units kept was as follows: 1934, 25.0 units; 1935, 23.3 units; 1936, 20.0 units; 1937, 25.5 units; and 1938, 27.0 units. The reduction in livestock was probably due to a decrease in the amount of feed available resulting from both the change in farm plans and the droughts in 1934 and 1936. The reduction

in depleting and the increase in conserving crops will cause a slight decrease in the amount of feed produced during the period of reorganization due to the reduction in the acreage of grain. The improvement of the meadows should enable the operator to increase the amount of hay-consuming animals on the farm.

240 Acre Farm. The change in land use on a 240 acre farm on which both the depleting and conserving crops were increased is shown in Table XVI. Although the acreage of depleting crops will be greater under the new farm plans, erosion should be less due to the fact that practically all of the crop land will be eventually strip-cropped. The type of hay has been improved by the production of some alfalfa. The permanent pasture improvement program included 20 acres in 1935, 12 acres in 1936 and none in 1937 and 1938. From the standpoint of convenience and economy, approximately

Table XVI. Land Use 1934-38 on a 240 Acre Salt Creek Farm on Which the Depleting and Conserving Crops Were Increased

Land Use	1934	1935	1936	1937	1938
	Acres	Acres	Acres	Acres	Acres
Corn	16	19	17	17½	18
Wheat	12	15½	20	18	18
Total depleting crops	28	34½	37	35½	36
Clover hay	10	0	8½	0	18
Clover-timothy hay	23	12	6	10	0
Timothy hay	0	14	20	30	18½
Alfalfa hay	0	5	5	6½	8½
Total conserving crops	33	31	39½	46½	46
Total rotated area	61	65½	76½	82	82
Woods	15	13	13	13	13
Pasture(1)	151	143	143	139	139
Roads, buildings, waste	13	18½	7½	6	6
Total farm area	240	240	240	240	240

(1) Includes rotation and permanent pasture.

the same amount of improvement should be done each year. The calculated productivity balance changed from -.7 per cent in 1934 to -.1 per cent in 1938.

The amount of livestock increased from 39.5 animal units in 1934 to 42 animal units in 1938. This increase was probably due to the additional feed under the new farm plans. The trend in livestock production from 1934-38 has been in the direction of more beef cattle and less sheep.

Some General Observations of the Soil and Water Conservation Program

The fact that the complete adoption of a soil conservation program on many farms requires a period of years makes the five-year study too short to measure all of the effects of the conservation practices; therefore, consideration should be given to some of the possible economic effects of soil and water conservation. Soil depleting practices cause a decline in crop yield and eventually the abandonment of the land. Thus, soil depleting practices lead to a reduction in the amount of feed produced, a decrease in the volume of business and a decline in the labor income, although current expenses may be slightly reduced. Soil conservation practices should be considered as part of a sound farm management program, if the farm is to be maintained as a producing unit.

From a soil conservation standpoint the change in land use on the majority of the farms involves a reduction in depleting and an increase in conserving crops. Thus, the immediate effect will be the production of less grain and more hay; however, after a few years the grain yields may increase enough on some farms to offset the loss in production from the reduced acreage of grain. The production of more hay will probably lead to more efficient feeding of livestock, the raising of more hay-

consuming animals, or the plowing under of excess hay for soil improvement purposes. On most farms more labor will be required under the new farm organization, especially for harvesting the additional hay. The additional cash outlay for following a soil conservation program will be made for the purchase of additional lime and fertilizer.

On most farms the immediate effect of the adoption of a soil conservation program will be a slight reduction in the labor income since the economic returns from lime and fertilizer are not realized immediately after application. However, on most farms after a period of four to five years the additional receipts should equal or exceed the additional expenses of adopting the soil conservation practices, and at the same time the farm will be maintained as a producing unit.

Record Keeping for Soil Conservation Economic Research

In order to measure the results of soil conservation versus soil depleting practices more effectively, records should be kept on the two methods of farming. Although it is impossible to select two areas that are entirely similar in all respects, yet a check area may prove valuable in evaluating the economic benefits of the soil conservation practices. The influence of such physical factors as soil type, temperature, rainfall, etc., should be separated from the effects of the soil conservation practices, if one is to evaluate the conservation practices properly. Since farm practices are continually changing it is impossible to select an area on which farming conditions will remain static. Therefore, if a check area is used a comparison of the economic benefits between the two methods of farming would show the results of a soil conservation type of farming compared with the "old" methods of farming modified by the continual changes in agriculture. Since labor income depends upon

size of farm, crop yields, amount of livestock, efficiency of livestock, managerial ability of the operator and many other factors, a comparison of two areas in terms of labor income only may not show the economic effects of soil conservation practices. Therefore, it would seem that the following records, some of which are supplemental to the usual farm management records, should be useful in evaluating the economic effects of the various conservation practices in terms of the additional expenses incurred in adapting the practices, and the additional benefits from following these practices:

1. Changes in land use.
2. Yield per acre by fields.
3. Physical quantities of livestock and livestock products produced and sold.
4. Amount of lime, fertilizer and manure applied to each field.
5. Type of hay.
6. Quantity of feed bought and sold.
7. Receipts and expenses itemized in detail, also a beginning and closing inventory for the record period.
8. Use of labor including the number of hours required, the distribution throughout the year and the amount of family and hired labor used.
9. Use of farm power including the number of horse and tractor hours required and the distribution throughout the year.
10. Use of machinery and equipment including a record of the new machinery needed and the adaptability of the present machinery on the farm to the new farming practices.
11. Available barn space for additional feed and livestock.
12. Attitude of the farmer toward the program.
13. Problems encountered by the farmer in adopting the program.

Summary

This study is an analysis of some of the economic effects of the soil conservation practices adopted from 1934-38 on 35 farms in the Salt Creek Soil Conservation Demonstration Area located near Zanesville, Ohio. The conservation practices recommended for the area include in many cases (1) a change in land use; (2) the adoption of strip-cropping, contour cultivation, and terracing to control erosion; (3) the production of some alfalfa; and (4) the improvement of the permanent pastures.

The thirty-five farms were sorted on the basis of the recommended changes in land use: (1) farms on which the depleting crops were reduced and the conserving crops were increased; (2) farms on which the depleting and conserving crops were increased; (3) farms on which the depleting and conserving crops were decreased; and (4) farms on which the depleting crops were increased and the conserving crops were decreased. The first group represented approximately 52 per cent of the farms, the second group 23 per cent, the third group 18 per cent, and the fourth group 5 per cent of the farms.

An analysis of twenty-one farms in the above groupings indicated that the net income of the farmers in the first group should remain fairly constant or even increase after the recommended program is in full operation, the income of the second group should increase, and the income of the third group will probably decline more than otherwise for several years due to the reduction in the rotated area. On none of the groups have the results of the adopted conservation practices been completely realized because the effects will accumulate with time.

Some improvement in crop yields could be expected to occur during the first five-year period of the soil conservation program.

However, on many farms the benefits from the conservation practices may be greater in the second than in the first five-year period. The adoption of soil and water conservation practices on many farms will require several years; however, the maintenance of the farm as a producing unit should prove to be most profitable over a period of years.